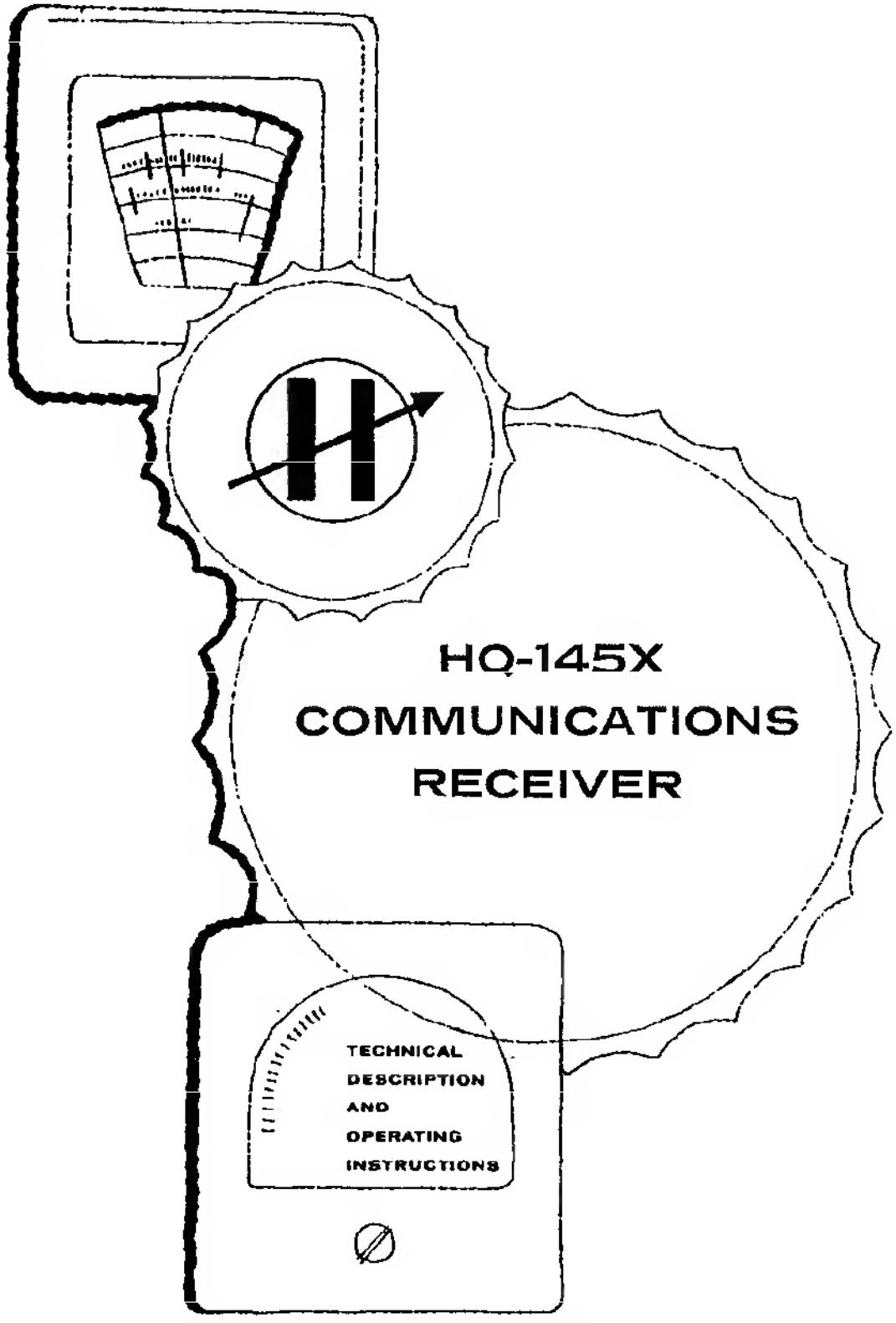


HQ-145X COMMUNICATIONS RECEIVER

TECHNICAL DESCRIPTION AND OPERATING INSTRUCTIONS

HAMMARLUND

Hammarlund Manufacturing Company
A Giannini Scientific Co.
53 West 23rd Street, New York 10, N. Y.
Export Department: 13 East 40th Street, New York 16, N. Y.

THE HQ-145X, HQ-145XC, HQ-145XE COMMUNICATIONS RECEIVER

INSTRUCTION AND SERVICE INFORMATION

ESTABLISHED 1910

Issue 1

In order to receive the full unconditional 90-day warranty against defective material and workmanship in this receiver, the warranty card must be filled out and mailed within two weeks of purchase. Please refer to serial number of warranty in correspondence.

THE HAMMARLUND MANUFACTURING CO.
53 West 23rd Street : : : New York 10, N. Y.

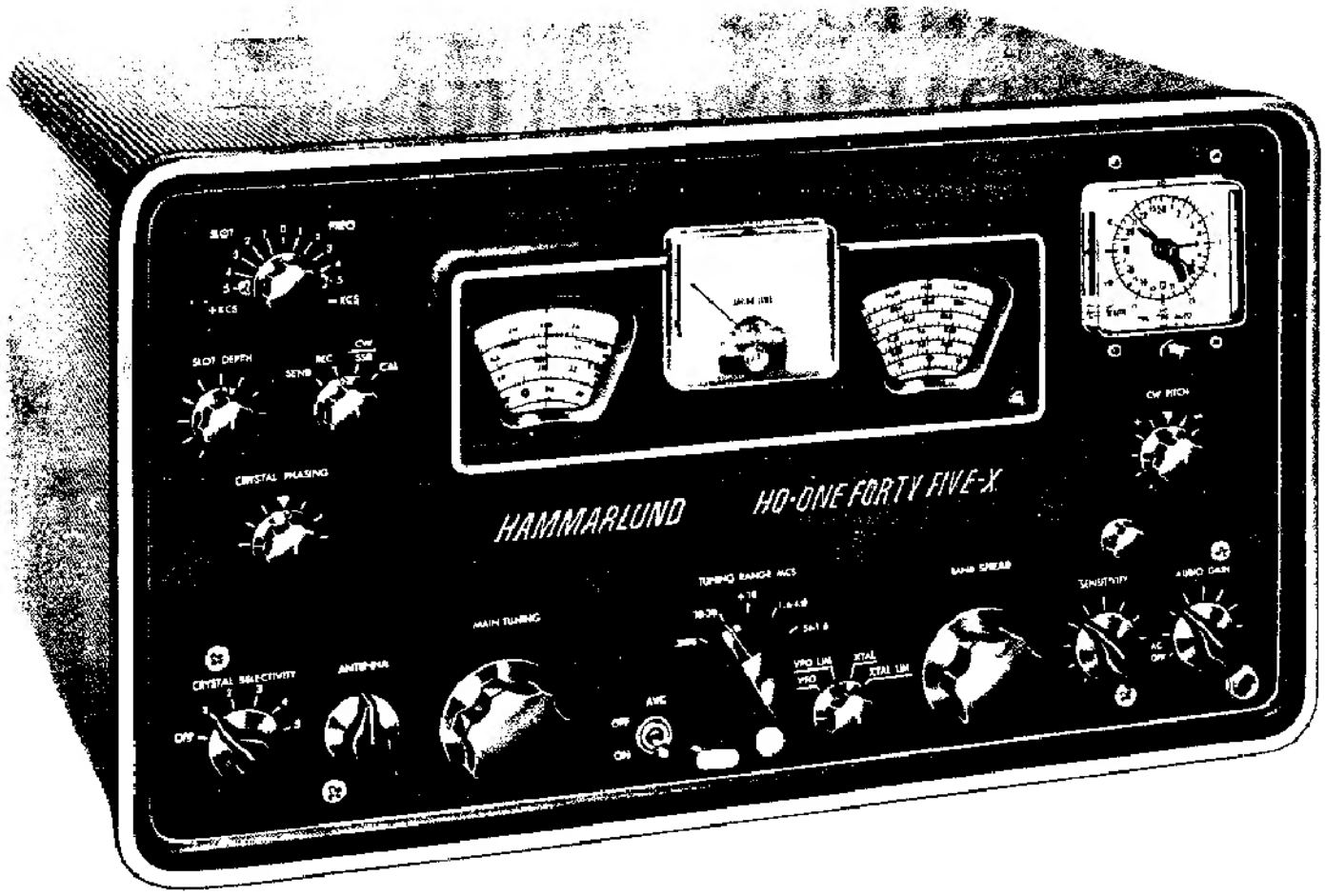


Figure 1. The HQ-145X Communications Receiver

SYMBOL	TYPE	TUBE COMPONENT TUBE	FUNCTION
V1	6BZ6	Pentode	RF Amplifier
V2	6BE6	Pentagrid Converter	1st Mixer
V3	6BE6	Pentagrid Converter	Converter or 455 Kcs IF Amplifier
V4	6BA6	Pentode	455 Kcs IF Amplifier
V5	6BA6	Pentode	455 Kcs IF Amplifier
V6	6AL5	Double Diode	Detector, Noise Limiter
V7	12AX7	Double Triode	455 Kcs BFO, Audio Amplifier
V8	6AQ5	Pentode	Audio Power Output
V9	6C4	Triode	High Frequency Oscillator
V10	OB2	Gas Filled Diode	Voltage Regulator
V11	5U4GB	Double Diode	Rectifier

INTRODUCTION

The Hammarlund HQ-145X multi-purpose continuous coverage communications receiver incorporates many new circuit innovations in addition to the well known Hammarlund crystal filter and series noise limiter circuits. It will provide years of top performance with a minimum of maintenance.

The HQ-145X receiver has a self-contained power supply operating from a 117 volt 60 cps source. The HQ-145XC incorporates a telechron automatic clock timer in its design. The export model HQ-145XE is capable of operation from a 115 or 230 volt 50 - 60 cps a-c power source. The export model, HQ-145XE, does not incorporate the telechron clock (with timer) because of the power line operating voltage and frequency.

The HQ-145X is an eleven tube continuous coverage (540 Kcs to 30 Mcs) superheterodyne receiver which employs the double conversion process on the 10 to 30 Mcs range and on the 20 Meter amateur bandspread position. The special bandspread ranges of 21.0 to 21.6 Mcs and 28.0 to 30.0 Mcs are included in the double conversion process.

Electrical bandspread tuning is provided with direct calibration every 10 Kcs on the 80, 40, and 20 meter bands; every 20 Kcs on the 15 meter band and every 50 Kcs on the 10 meter band. In addition an arbitrary bandspread logging scale is provided for use throughout the tuning range of the receiver. The bandspread dial is also provided with an adjustable hairline marker.

The 100 Kcs crystal calibrator (optional accessory) provides marker signals at every 100 Kcs on all bands for checking dial calibration accuracy. A tuned RF stage with the addition of an antenna trimmer assures maximum sensitivity and a high signal to noise ratio for outstanding reception of weak and distant signals. A manual sensitivity (RF gain) control prevents the receiver from overloading on strong signals.

The well known Hammarlund crystal filter provides optimum selectivity for high rejection of closely spaced interfering signals.

The HQ-145X communications receiver is equipped with an unusually stable beat frequency oscillator which provides the operator of the receiver with a range of audio tones for excellent reception of code (CW) signals, as well as (SSB) single side band signals.

One special feature of the HQ-145X receiver is a "razor sharp" adjustable slot filter to eliminate co-channel interference. A single knob controls the position of the "hole" in the IF passband and provides up to 40 db attenuation of the unwanted signals over a range of 10 Kcs. In addition, the slot depth control may be used to obtain an additional 20 db rejection at any single frequency.

Accurate reports of signal strength on AM reception are obtained with the aid of the "S" meter for that "on the nose" tuning. A send-receive switch is provided to silence the receiver while transmitting.

The receiver possesses the Auto Response feature which automatically narrows and widens the frequency range of the audio output, according to the gain required. This feature permits higher fidelity reception on stronger signals, while providing the sharp cut-off required in receiving communications under adverse conditions. A second advantage of the Hammarlund Auto-Response is the rapid damping of the audio power in the speaker voice coil which greatly minimizes undesirable speaker "hangover". The receiver may be used with either speaker or headphones. A-c hum is made inaudible by means of adequate power supply filtering.

Large comfortable controls in logical groupings are provided for the greatest of operating ease. The new futuristic front panel is clearly marked to permit full attention to the operation at hand.

The HQ-145X was designed with you in mind. You will have many hours of pleasure in operating this truly fine communications instrument.

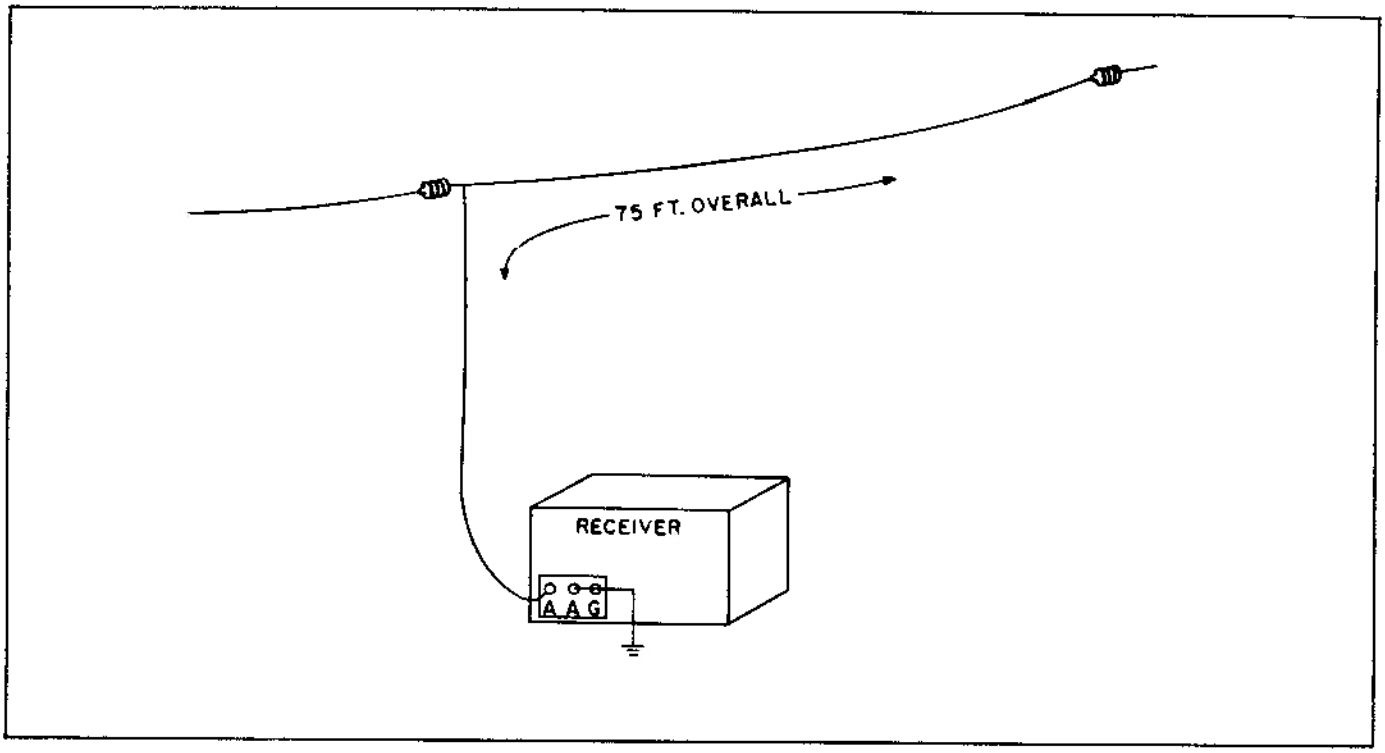


Figure 2. Installation of Single Wire Antenna

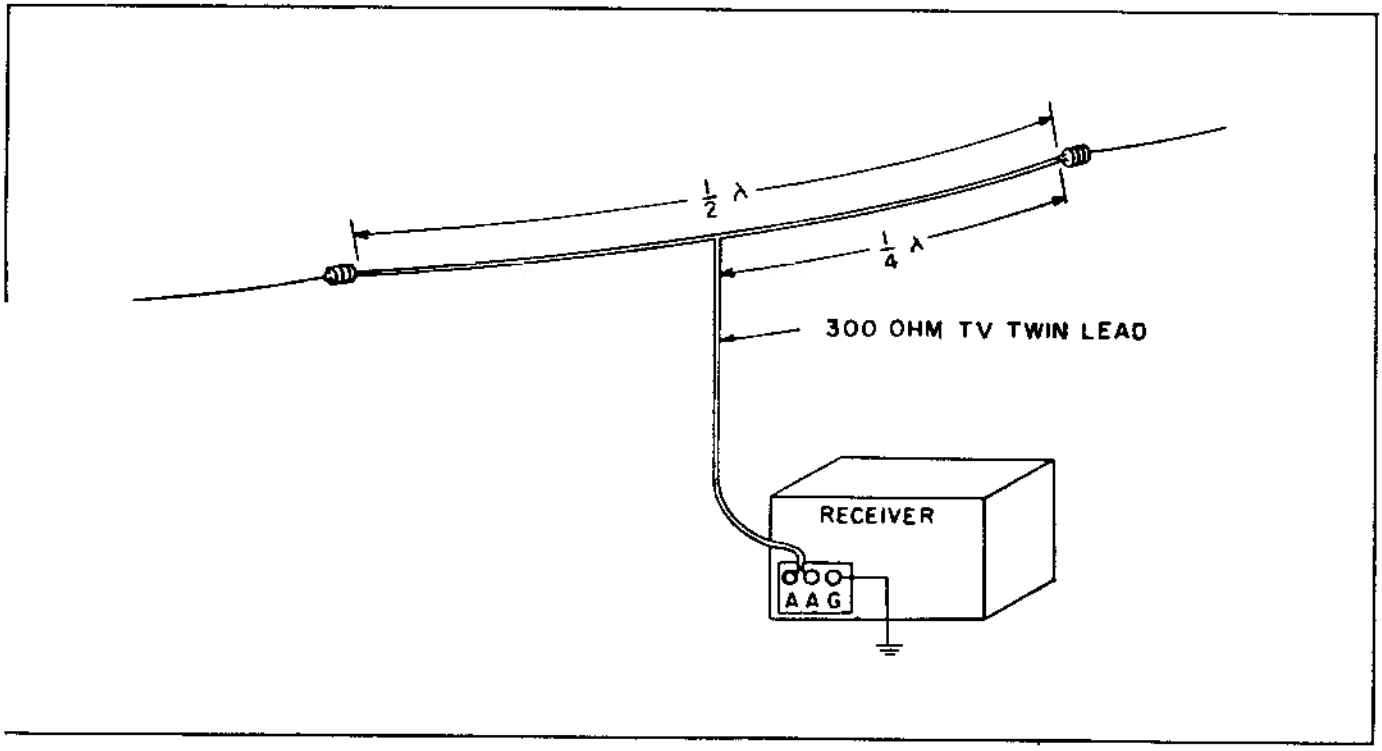


Figure 3. Installation of Folded Dipole Antenna

INSTALLATION

UNPACKING

Unpack the receiver carefully. Make sure the tubes, associated tube shields and pilot lamps are in place.

SPEAKER CONNECTION

Connect a 3.2 ohm permanent magnet speaker (Hammarlund S-200 Speaker) to the two terminals marked SPKR on the rear of the chassis. (Note Figure 4.) For best performance do not place speaker on top of receiver cabinet.

POWER CONNECTIONS

Before inserting attachment plug into power outlet, make certain power source is of proper voltage and frequency. (Refer to paragraph one of INTRODUCTION.)

INSTALLING ANTENNA

The HQ-145X is designed to operate with a single wire or a balanced type antenna. The front panel antenna trimmer control (Figure 5) permits a good match to most antenna systems of 50 to 600 ohms.

For general coverage, single wire antenna of 20 to 50 feet length will provide surprisingly good reception. A long single wire outdoor antenna, such as shown in Figure 2, will generally provide entirely satisfactory performance. This wire may be 50 to 150 feet long.

For best reception, the antenna should be isolated as much as possible from neighboring objects and at right angles to power lines or busy highways so as to minimize possible interference pickup.

Optimum performance on a particular amateur band or other narrow tuning range will be obtained by using a tuned half-wave dipole or folded dipole fed with 300 ohm transmission line or other suitable lead-in, as shown in Figure 3.

To tune the one-half wave length dipole, the following formula for the length of the antenna may be used:

$$\text{Length (feet)} = \frac{463}{\text{Freq. (MCS)}}$$

Each half (1/4 wave length) is half the length found from the above formula.

A good ground, although not always necessary, will generally aid in reception and reduce stray line hum. Reversal of polarity of power cord plug may possibly further reduce line hum in some locations.

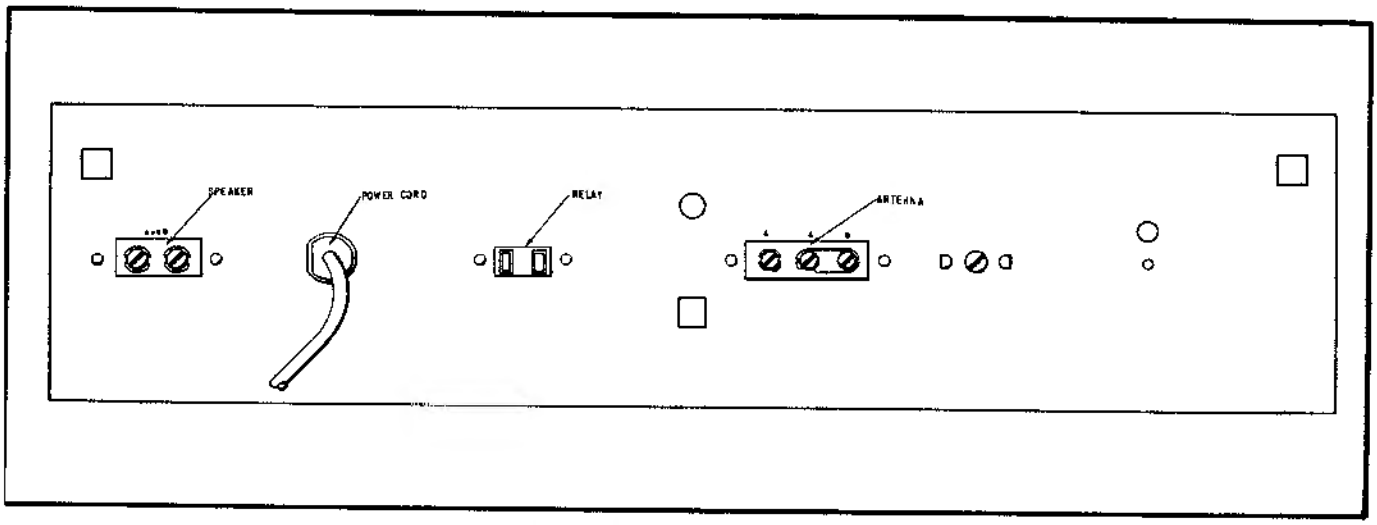


Figure 4. Connection Points at Rear of Chassis

BREAK-IN RELAY

The receiver is equipped with a female chassis connector at the rear of the chassis, alongside the power cord entry bushing. Its purpose is to provide connection of a suitable relay for remote control operation of the receiver. As shipped from the factory the two terminal plug wires are connected in series with the Send-Receive-CW/SSB Cal Switch. For remote control operation connect relay contacts to the receptacle by means of a 117V a.c. standard power plug after removing the jumper plug (shorting bar).

The usual antenna change-over relay equipped with an extra set of normally closed contacts (receiver operating) is suggested. The choice of this relay will depend on the particular antenna system involved, such as whether a coax relay or one for open-wire line is employed.

Remember that with this system of remote operation, the relay performs the sole function enabling you to hear or not to hear signals in the loud speaker.

The Function Switch located on the front panel determines the type of reception that you desire (AM-CW-SSB-CAL).

The Send-Receive part of the Function Switch controls the receiver independent of the Break-in Relay (provided that the relay receptacle pins are shorted by either the relay contacts or the wire jumper).

CAUTION

The receptacle pins open and close a part of the +105 volt dc regulated supply load; consequently, check all external wires and the relay for possible short circuits to ground.

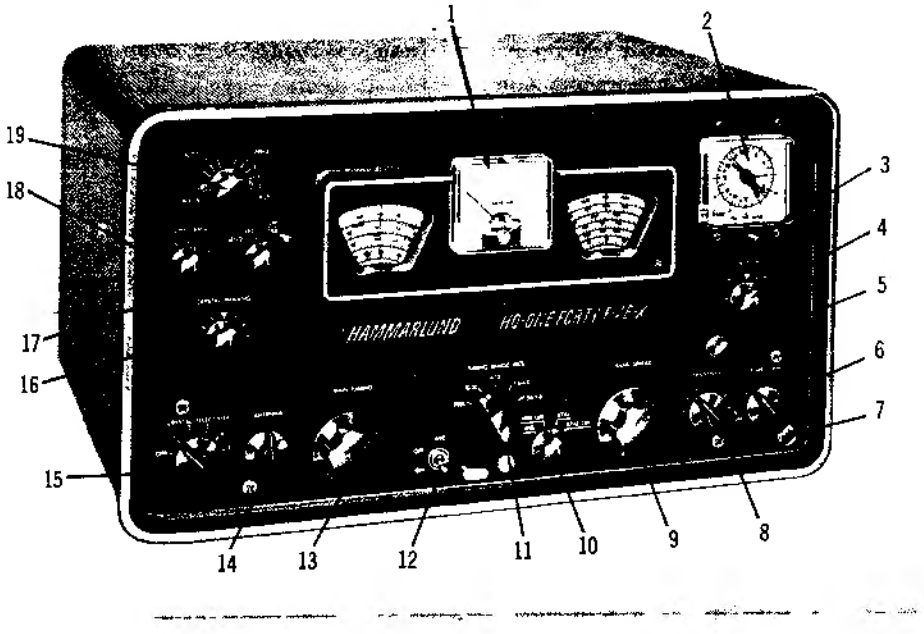


Figure 5. Location of Controls (Front Panel)

1. "S" Meter Carrier Level
2. Telechron Automatic Clock (Timer)
3. Timer Switch
4. Beat Frequency Oscillator Control (CW Pitch)
5. Calibration Set Control
6. Audio Frequency Gain Control
7. Phone Jack (Output for Headphone Operation)
8. RF Sensitivity Control
9. Bandspread Tuniag Control
10. VFO Limiter Switch (VFO-VFO-LIM-XTL-XTL-LIM)
11. Tuning Range Switch (Band Selector)
12. AVC ON-OFF
13. Main Tuning Control
14. Antenna Trimmer
15. Bandwidth Selector
16. Crystal Phasing Control
17. Function Switch (Send-Receive-CW/SSB-Calibrator)
18. Slot Depth Control
19. Slot Frequency Control

GENERAL OPERATING INSTRUCTIONS

MAIN TUNING

The Main Tuning dial provides continuous coverage throughout the entire range of the receiver. In order for the Main Dial calibration to be accurate, the bandspread dial scale must be set at the indicated vertical marking which is located at the extreme clockwise end of its dial scale.

BAND SPREAD TUNING

The Band Spread Dial scale provides expanded dial scale coverage on the 80, 40, 20, 15 and 10 meter amateur bands. To use the Band Spread Dial, set the Main Dial scale to the highest indicated frequency of the amateur band in which operation is desired. The amateur bands are prominently shown on the Main Dial scale by means of the boxed off areas.

20 METER BAND SPREAD POSITION

A special 20 Meter Band Spread position is incorporated in the Tuning Range switch to provide the optimum dial scale spread on this band. To obtain the proper dial calibration on the 20 Meter bandspread dial, the Tuning Range switch must indicate 20 BS. The adjustment of the Main Tuning dial for bandspread operation is the same as previously mentioned. (The BS dial calibration is inaccurate on the 15 and 10 Meter bands when the Tuning Range switch indicates 20 BS).

100 KCS CRYSTAL CALIBRATOR (OPTIONAL ACCESSORY)

The 100 Kcs crystal calibrator provides 100 Kcs check points for precise calibration throughout the range covered by the receiver. The 100 Kcs crystal controlled oscillator has been set at the factory with sufficient accuracy for all practical purposes.

For dial calibration checking, the Send-Receive-CW/SSB-Calibrate switch is set to CAL position and all other controls should be set as listed under Code or SSB Reception.

The receiver is adjusted with the Band Spread Cal Set line aligned to the vertical marker and should be reasonably correct. The Cal Set knob is used to accurately reset the B.S. dial indicator line if it is found to be slightly off calibration at any area on the dial where precise calibration is desired.

SUGGESTED TUNING PROCEDURE

First set the bandspread dial at the high frequency end of the particular amateur band. Next set the main tuning dial to the high frequency end of the band. If a 100 Kcs crystal calibrator is available, the Main tuning dial should be carefully adjusted, plus or minus the high frequency band edge marker until the 100 Kcs calibrator is heard. Care must be taken that the proper 100 Kcs marker is employed in order to prevent setting the main tuning dial 100 Kcs higher or lower than the band edge. Next rotate the bandspread dial to the 100 Kcs marker nearest to the center of the bandspread tuning range. It will undoubtedly be found that upon doing this, the 100 Kcs marker will be plus or minus of the exact frequency. The bandspread dial is therefore set to the exact 100 Kcs marking, and the main tuning dial is then very carefully adjusted until whatever error existed in the bandspread dial reading has been corrected. Once this condition has been obtained, the main tuning dial should be left alone and all tuning of the amateur bands accomplished with the bandspread tuning dial. Using this procedure of setting the bandspread dial near the center of its tuning range will halve the frequency error that may result when either band edge alignment is employed.

In the event that the 100 Kcs crystal calibrator is not available, a signal of known frequency, such as harmonics from the crystal oscillator in your transmitter, should be set up accurately on the BANDSPREAD tuning dial and the MAIN taning dial rotated very carefully, plus or minus, from the high frequency band edge marker until the signal of known frequency reads correctly on the bandspread dial. For best accuracy of bandspread dial calibration, the known frequency should preferably be near the center of the bandspread dial tuniag range, since, here again, this will result in halving the possible error that may result by setting up the bandspread dial to a known frequen-

cy at or near either of the band edges.

Without a 100 Kcs crystal calibrator or a known frequency, setting up the main tuning dial to the high frequency band edge marker may result in the bandspread tuning dial being off by as much as 100 Kcs or more. If the above procedure is followed, the bandspread tuning dial will usually read to within approximately 15 Kcs or better of the exact frequency.

TELECHRON AUTOMATIC TIMER

If your receiver is equipped with the built-in Telechron Automatic Clock-Timer, the following instructions should be noted:

Every radio-frequency device is stable only at pre-determined operating temperatures. In order to eliminate waiting for the receiver to warm-up to operating temperature, the Telechron Timer automatically turns on the receiver ahead of anticipated operating time. This is accomplished by setting the hand of the timer (small knob at rear of receiver) to approximately one-half hour before operating time. The front panel control under Timer is then set to "Auto" position. The function switch is set to REC. The receiver is then automatically turned on at the desired time.

The clock hands are set by the rear knob. "Push in" and turn the knob to set the switch timing hand and "pull out" and turn the knob to set the clock hands. The front switch is set to AUTO and the function switch is set to REC. when it is desired to use the automatic clock switch for pre-warming the receiver before operation or for use as an alarm to turn the receiver on to a pre-tuned station. To use the function switch normally, the clock switch should be left in the ON position.

The clock will continue to run as long as the receiver line cord is connected to the power outlet, and is extremely useful for checking sign-in periods and schedules.

If your receiver is not equipped with the Telechron Automatic Clock-Timer, and you would care to have the accessory added, The Clock Kit, with full installation instructions, may be purchased from your local Hammarlund dealer.

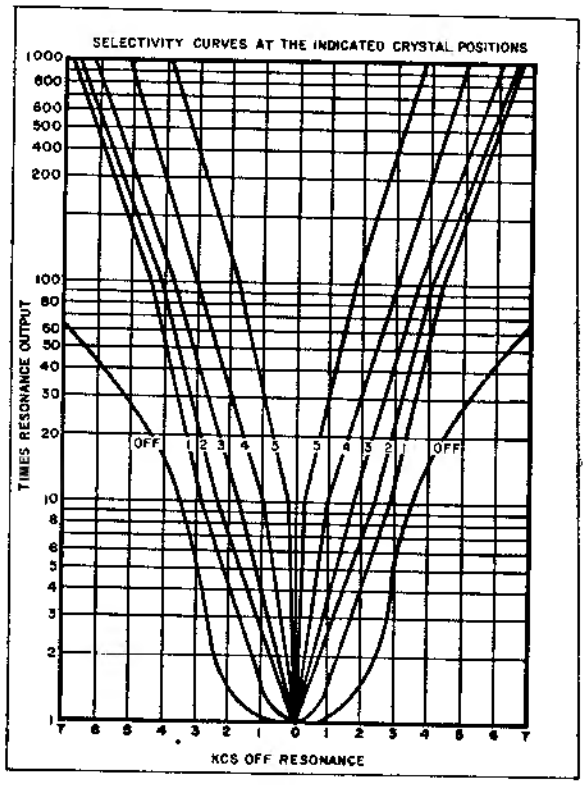


Figure 6. Selectivity Curves

OPERATION

AM RECEPTION

For AM reception the position of the controls nominally should be as follows:

Send-Receive-CW/SSB-Cal Switch	Receive
Selectivity Switch	*Off
Crystal Phasing	Triangular Marker
Slot Frequency	***Clockwise
Slot Depth	****See detailed instructions for use of slot filter
Main Tuning Control	Tune for the highest "S" Meter reading
Band Spread Control	Extreme Clockwise marking
Tuning Range Switch	Set to desired frequency range
Antenna Trimmer	Tune for the highest "S" meter reading
AVC ON-OFF Switch	ON
VFO Limiter Switch	VFO
RF (Sensitivity) Control	**Fully Clockwise
AF (Gain) Control	*****Adjust to desired level
Timer Switch	ON
Beat Frequency Oscillator Control	Triangular Marker

* To obtain Maximum fidelity in AM Reception, the widest bandwidth is normally used. However, under conditions of severe interference from spurious signals or atmospheric noise, the bandwidth is reduced to improve intelligibility although some sacrifice of fidelity results. Adjust crystal selectivity to suit reception conditions.

** For normal AM reception, the RF gain control is rotated fully clockwise. The "S" meter calibration holds only when the Manual-AVC switch is on AVC. In the presence of extremely strong signals, the RF (Sensitivity) Control may be reduced to limit meter swing.

*** The Slot Frequency control provides an extremely sharp adjustable slot or hole in the selectivity curve (See Figure 7). It is normally located outside of the passband of the 455 Kcs IF Amplifier system. It is brought into the passband for the purpose of eliminating interference from heterodyne signals on AM and monkey chatter on SSB. On CW Reception, the Slot Filter will materially aid in reducing or eliminating adjacent or co-channel interference.

CAUTION

When tuning the receiver across any band, make certain that the Slot Frequency control is at the 5 Kcs position not on "O".

**** The Slot Depth control is actually a very gradual vernier adjustment. In view of this its effect will not be very noticeable unless the proper procedure is employed. The suggested procedure is as follows:

Tune in a broadcast signal on the broadcast band or any other strong constant carrier of similar nature. Whenever the receiver is being tuned for normal reception be sure to first rotate the Slot Frequency control to the extreme clockwise or counter clockwise position. In other words, never leave the Slot Frequency control at or near the zero setting. If this procedure is not followed it is obvious that the center of the passband will be slotted out, some cases this being made quite obvious by producing 2 spot tuning or 2 peak "S" meter readings.

After tuning in the constant carrier, peaking the "S" meter, and taking the above precautions, rotate the Slot Frequency control. It will be noticed that upon approaching the zero setting, the "S" meter reading will be affected. A very definite null or minimum "S" meter reading will be obtained with the Slot Frequency control adjusted at or near zero. Observe this "S" meter reading. With the Slot Frequency control set at the minimum "S" meter reading position, the Slot Depth control should be rotated very slowly throughout its range, obeerving the "S" meter. It will be found that at one particular spot throughout the range of the Slot Depth control a further reduction in the "S" meter reading will be obtained. A very slight readjustment of the Slot Frequsncy may now result in a further reduction of the "S" meter reading. Once this setting has been obtained, the Slot Depth control may be left permanently in this position, and all future Slot Filter adjustments made by the Slot Frequency control only.

A periodic check of the slot depth control setting may be available.

*****A feature of the audio system is the variable negative feedback emloyed. Maximum feedback is provided at low settings of the Audio Gain Control for maximum quality reception of strong signals. As the Audio Gain Control is increased, the feedback decreases to provide additional selectivity by the audio system for reception of weak signals. This results in an increased signal to noise ratio. A further advantage is the critical damping of the speaker for the elimination of speaker "hangover". This upgrades the reception of speech and decreases receiver output noise. Another advantage is the reduction of distortion at low settings of the Audio Gain Control.

* To operate on either of the crystal control positions, (ie with or without noise limiter) it is only necessary to plug in the appropriate crystal and tune to the desired frequency on the receiver dial. The input signal will "lock in" at or near the frequency to be received and may be peaked on the "S" Meter with the tuning knob.

To calculate the proper crystal frequency to be used for a given channel frequency, it is only necessary to add 455 kcs to the input frequency to be received. This applies to the first 3 bands only covering the range of .54 to 10 mcs. On band 4 (10-30) mcs. and 20 BS positions, double conversion is employed and the crystal frequency should be either 3035 kcs above or below the input signal frequency. It is suggested that the crystal frequency be below the input signal as this will provide for more stable operation as the frequency employed increases. Also standard CR-18/U type crystals for use in a 32 mmf fundamental mode circuit are available up to 30 mcs. If the local oscillator were crystal controlled above the input signal, it would only be possible to receive up to approximately 37 mcs, due to availability of crystal frequencies.

The basic accuracy of available crystals is either .005% or .002% and may be trimmed to an accuracy of better than .001% by means of the trimmer capacitor located on the front panel.

Calculating crystal frequency:

Bands 1, 2, 3	$F_{Crystal}$	$=F_{Signal}$	+455 Kcs
Bands 4, 5	$F_{Crystal}$	$=F_{Signal}$	$\pm$3035 Kcs

EXAMPLES:

BAND		SIGNAL	CRYSTAL F
1	.54- 1.6 Mcs	1.0 Mcs	.1455 Kcs
2	1.6 - 4.0 Mcs	2.5 Mcs.	.2955 Kcs
3	4.0 -10 Mcs	7.5 Mcs.	.7955 Kcs
4	10 -30 Mcs	15.0 Mcs.	11.965 Mcs
4	10 -30 Mcs	30.0 Mcs.	26.965 Mcs
4	10 -30 Mcs	15.0	18.035 Mcs

CODE OR SINGLE SIDEBAND RECEPTION

For CW Code reception the position of the controls nominally should be as follows:

Send-Receive-CW/SSB-Cal Switch	CW/SSB
Selectivity	*OFF
Crystal Phasing	Triangular Marking
Slot Frequency	Clockwise
Slot Depth	See AM Rec.
Main Tuning Control	Tune for loudest signal
Band Spread Control	**Tune for loudest signal, if used
Tuning Range Switch	Set to desired frequency range
Antenna Trimmer	Tune for the loudest signal
AVC ON-OFF Switch	OFF
VFO Limiter Switch	VFO
RF (Sensitivity) Control	Adjust to desired output level
AF (Gain) Control	3/4 Clockwise
Timer Switch	ON

Beat Frequency Oscillator	***Tune signal to zero beat with knob pointing to triangular marking, then turn off zero beat in either direction for desired tone on CW or best intelligibility on Single Sidebands Reception.

* Under conditions of severe interference, increase the selectivity of the receiver by turning knob to a higher position.

** For Single Side Band Reception adjust band spread knob for the loudest signal; then use the BFO knob for "zeroing in" to the exact frequency, or for best speech intelligibility.

*** The CW Pitch Control markings (+) and (-) indicate the position of the Beat Frequency Oscillator with respect to the center of the IF passband.

*** When a Single Sideband signal is received, the CW Pitch knob must be turned in the correct direction so that the re-inserted carrier (provided by the BFO) has the proper phase relationship to the sideband signal. For upper sideband signal reception, the CW Pitch knob must be set on the plus (+) side for intelligible reception. For lower sideband reception, the CW Pitch knob must be set on the minus (-) side for intelligible reception.

The RF (sensitivity) control should be advanced the least amount required for the desired audio output. The use of a minimum sensitivity control setting insures that no overload distortion occurs in the receiver for single sideband reception.

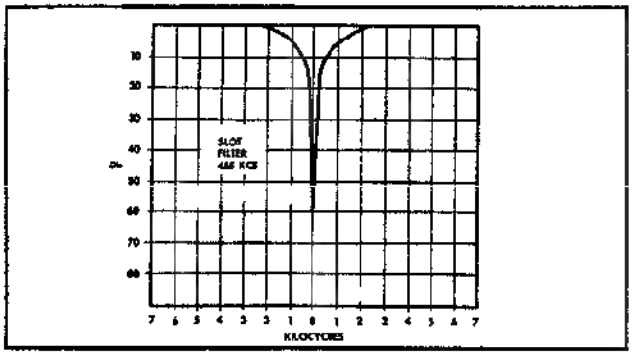


Figure 7. Slot Filter Response Curve

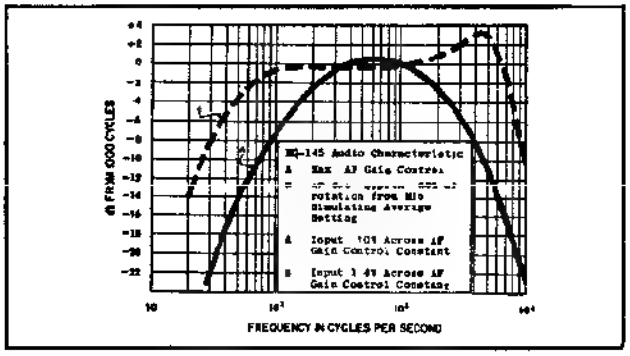


Figure 8. Auto Response Curve

CIRCUIT THEORY

The HQ-145X superheterodyne communications receiver employs double conversion on all signals above 10 megacycles. This receiver provides continuous coverage of all signals between the range of 540 kilocycles and 30 megacycles. Twelve tubes are used including the Rectifier, the voltage regulator, and 100 Kcs Crystal Calibrator (optional accessory). The circuitry of the receiver includes an adjustable IF bandwidth selector (crystal filter), a crystal phasing control, a slot frequency and depth control, a series noise limiter and special band spread ranges for the 80, 40, 20, 15 and 10 meter amateur radio bands.

* The HQ-145X has provisions for crystal control of the local oscillator. This circuit operates as a conventional variable frequency device tracking with the input tuning of the receiver, or as a crystal controlled device operating on any one frequency within the range of the receiver.

The switching of the oscillator, has been conveniently combined with the Noise Limiter switch. As now employed in the HQ-145X, a four position rotary switch (VFO Limiter Switch) provides the following functions:

Position 1	VFO
Position 2	VFO-Limiter
Position 3	Xtal
Position 4	Xtal-Limiter

On Position 1, the receiver operated in the conventional manner with the VFO limiter out of the circuit, on Position 2, the limiter is in the circuit. Positions 3 and 4 provide the same functions for crystal control.

When the VFO-Xtal switch is in either positions 1 or 2, the local high frequency oscillator operates as a VFO in a conventional Hartley circuit. On positions 3 and 4, the oscillator configuration is changed to a crystal controlled modified Colpitts (Pierce) circuit.

PRE-SELECTION

The antenna input coupling and RF amplifier stage provide the necessary pre-selection and gain for high performance and rejection of undesired signals. The high signal level at the 1st mixer grid, V2, contributes to a favorable signal-to-noise ratio.

Both grid and plate circuits of the RF stage are tuned (except plate circuit on .54 - 1.6 Mcs Band); individual tuning coils are selected for each band.

The antenna compensation capacitor, adjustable from the front panel, permits the receiver to be resonated for optimum performance with the particular antenna in use.

CONVERTER STAGE

A high degree of oscillator stability is attained by the use of a separate mixer (6BE6) V2, and an independent oscillator (6C4) V9.

The output signal from the RF amplifier V1 is heterodyned with the output of the local high frequency oscillator V9 and electronically combined within the mixer tube V2. On the .54 to 1.6 Mcs, 1.6 to 4.0 Mcs, and 4.0 to 10.0 Mcs bands the local oscillator is located 455 Kcs above the signal frequency. On the 10.0 to 30.0 Mcs and the 20 meter bandspread positions the local HF oscillator is located at 3035 Kcs above the signal frequency.

When operating on 10.0 to 30.0 Mcs and the 20, 15 and 10 meter band spread positions, the difference frequency of 3035 Kcs is heterodyned with the output of the 2580 Kcs crystal controlled oscillator and electronically combined in the converter tube V3 (6BE6), to produce 455 Kcs, 2nd IF. When the Band Selector switch indicates .54 - 1.6 Mcs, 1.6 - 4.0 Mcs, or 4.0 - 10.0 Mcs, the crystal oscillator section of the converter tube ceases to oscillate, and the converter becomes a regular 455 Kcs IF amplifier.

Low-loss tube sockets, low-loss phenolic insulation, temperature compensating capacitors, and stable coaxial trimmers all contribute to the excellent oscillator's stability. Additional frequency stability is attained by applying a regulated voltage to the oscillator circuit, and by the rugged constructional design of the entire HF oscillator section.

455 KCS IF AMPLIFIER

The output of the second conversion Stage V3 is fed into two stages of 455 Kcs IF amplification. The interstage coupling network to the first tube contains the well known Hammarlund 455 Kcs Crystal Filter and phasing network.

The Crystal Selectivity switch provides six different bandwidths which enable the operator to successfully receive signals under the most severe conditions of interference due to atmospheric or man made noises. The six position Selectivity switch includes an Off position (highest fidelity) and five progressively increasing selective bandwidths as shown in Figure 5.

Switch positions Off, 1, 2 and 3 are recommended for phone or single sideband reception. Positions 4, and 5 are recommended for reliable CW or code reception. The phasing capacitor C16 may be adjusted to provide additional rejection to very strong, closely spaced, interfering signals.

The output circuit of the first 455 Kcs IF amplifier consists of two IF transformers T9 and T10 which are interconnected by means of a network of resistors, capacitors, and coils comprising the Slot Filter section. This low-impedance network forms a balanced bridge arrangement known as a Bifilar "T" trap. The slot filter inductor L3 and slot tuning capacitor C22 (with capacitors C20, and C21) form a tuned circuit which presents a very high impedance to signals passing through at the resonant frequency (See Figure 7). Resistive balance is controlled by the Slot Depth potentiometer R21.

DETECTOR AND NOISE LIMITER

One section of the 6AL5 tube, V6, is used for the second detector and AVC system. This system produces a minimum of distortion.

The other half of V6 operates as a series, self-adjusting noise limiter. It will reduce automobile ignition and other types of impulse noise to minimum. Intelligibility is not affected by the noise limiter, although it may be switched off if desired.

AVC SYSTEM

Automatic Volume Control minimizes fading and signal strength variations by controlling the gain of the RF stage VI and IF stage V4. As a result, a comfortable and constant level of audio is maintained.

AUDIO AMPLIFIER

The first audio stage is resistance coupled voltage amplifier employing one section of the 12AX7 (V7A). The audio output stage is a 6AQ5 beam power amplifier (V8) providing an undistorted output level of at least one watt.

A feature of the audio system is the variable negative feedback employed (See Auto-Response Curve, Figure 8). Maximum feedback is provided at low settings of the AUDIO GAIN control for the fine quality reception of local broadcast and strong short wave stations. As the AUDIO GAIN control is increased, the feedback decreases, so that on reception of weak signals additional selectivity is provided by the audio section. This results in an increased signal-to-noise ratio. A further advantage is the critical damping of the speaker for elimination of speaker "hangover". This upgrades the reception of speech and music and decreases the noise output of the receiver. Another advantage is the reduction of distortion at lower settings of the AUDIO GAIN control.

"S" METER (CARRIER LEVEL)

The "S", or Tuning, Meter is provided to assist in tuning and to give an indication of relative signal strength. Because the meter readings are proportional to AVC voltage, it is operative only in the Receive Position with AVC "ON".

The meter, which is calibrated to 40 db over S-9, is factory adjusted so that a signal input of approximately 50 microvolts gives a reading of S-9. Each "S" unit indicates a 6 db increase, equivalent to doubling signal strength. Should meter readjustment be necessary:

1. With receiver off, mechanically adjust meter pointer to zero with the aid of a small screw-driver.
2. Turn power on, set function switch to REC., and Sensitivity control to MAX.
3. Allow the receiver to warm up for at least 15 minutes.
4. With AVC ON, and the Antenna Terminals shorted, turn Zero Adjust potentiometer R24 until meter pointer indicates "0".

BEAT FREQUENCY OSCILLATOR

The Beat Frequency Oscillator control L8 varies the tuning of the 455 Kcs BFO (1/2 of 12AX7-V7B) over a range from zero beat to plus or minus 2 Kcs. The BFO is connected in an ultra stable modified Colpitts Oscillator circuit. The high C to L ratio tuned circuit with the addition of the temperature compensating capacitor C56 substantially contribute to the outstanding performance of this section of the receiver.

CRYSTAL CALIBRATOR (OPTIONAL ACCESSORY)

A 6BZ6 vacuum tube, a hermetically sealed quality quartz crystal unit, and associated components form a highly stable 100 Kcs crystal-controlled oscillator to provide calibrating markers at 100 Kcs intervals throughout the range of the receiver. A ceramic trimmer capacitor located on the calibrator assembly is provided for accurately adjusting the oscillator frequency to zero beat with any primary frequency standard signal off the air such as "WWV".

SERVICE AND ALIGNMENT PROCEDURE

NOTE

Before servicing this receiver, disconnect the unit from the power source and remove all lead wires attached to the terminal connections located at the rear of the chassis apron. Carefully turn the receiver on its front panel and rest the unit on top of smooth clean surface (preferably a soft cloth). Remove the three No. 10 Hexagon head machine screws which fasten the chassis to the cabinet at the rear skirt. Remove the knob from the clock adjustment shaft if the receiver is equipped with a clock assembly. Lift the cabinet straight up and off the chassis. To re-assembly, reverse this procedure.

RF AND IF ALIGNMENT

Two non-metallic alignment tools are required for the complete alignment:

General Cement Co. No. 5097 or equal
General Cement Co. No. 8282 or equal

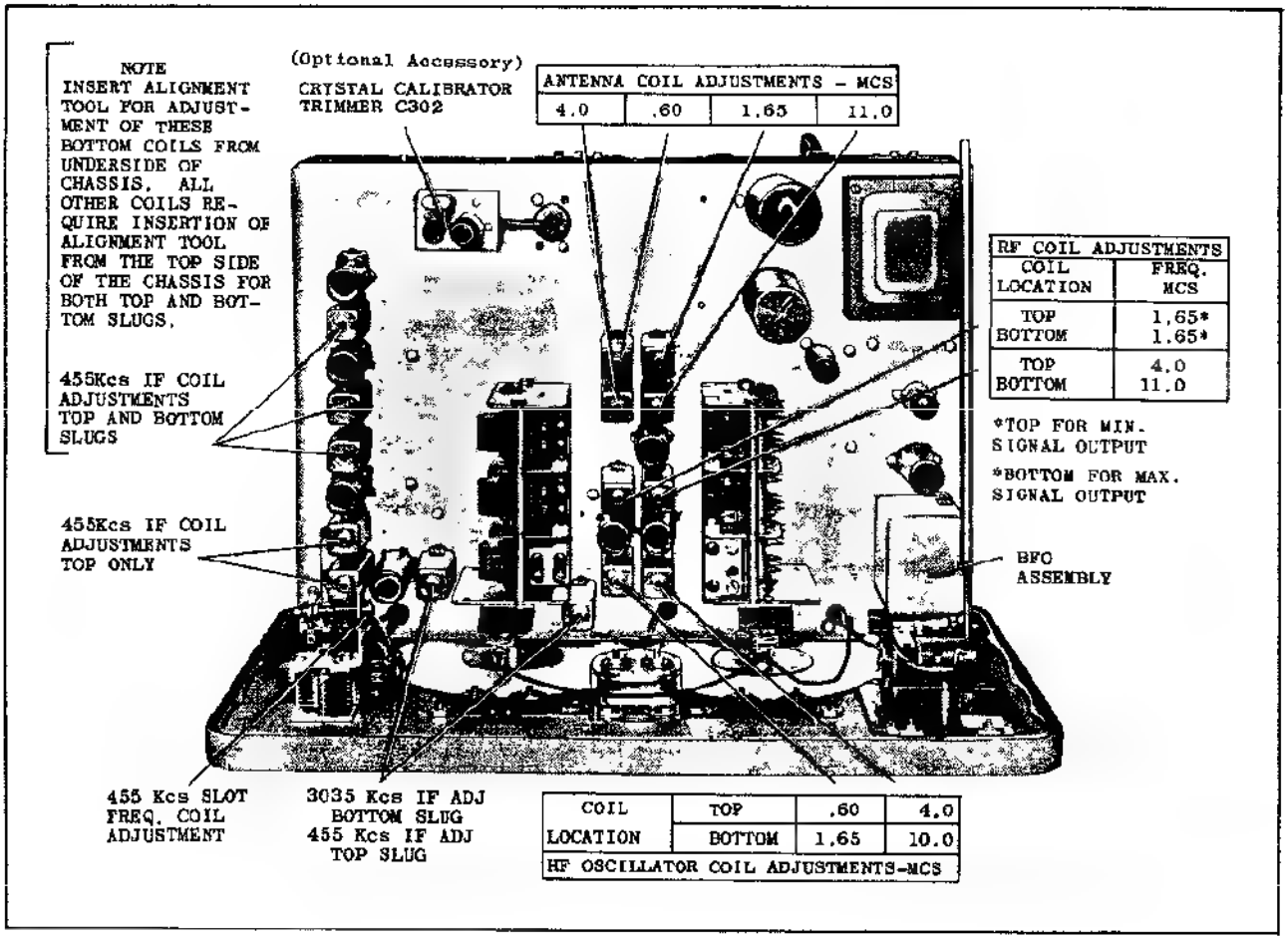


Figure 9. Top View of Chassis

Unless otherwise specified, the front panel controls shall be positioned as follows for the complete alignment of the receiver:

Send Receive-CW/ SSB-Cal Switch	Receive
Selectivity Switch	Off
Crystal Phasing	Triangular Marker (Mid-position)
Slot Frequency	Clockwise
Slot Depth	Clockwise
Main Tuning Control	4.0 Mcs
Band Spread Control	Extreme Clockwise Marking
Tuning Range Switch	1.8 - 4.0 Mcs
Antenna Trimmer	Mid-position
AVC ON-OFF Switch	OFF
VFO Limiter Switch	VFO
RF (Sensitivity) Control	Adjust to prevent overloading
AF (Gain) Control	Minimum Gain
Timer Switch	On
Beat Frequency Oscillator Control	Triangular Marker (Mid-position)

NOTE

The receiver should be warmed up for a period of at least 1/2 hour before proceeding with the complete alignment.

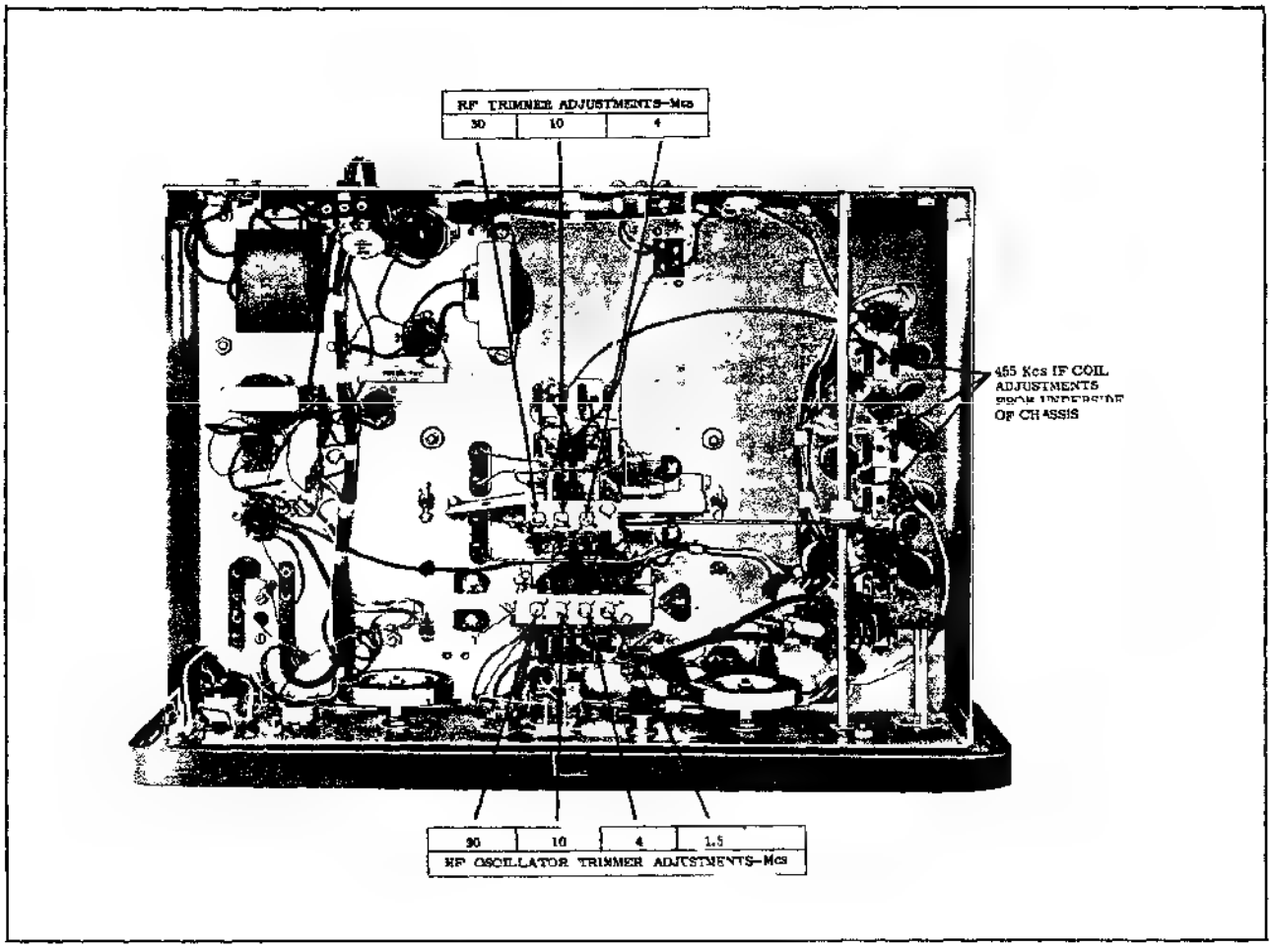


Figure 10. Bottom View of Chassis

IF ALIGNMENT

A high degree of stability has been designed into the receiver making re-alignment unnecessary unless electrical parts are replaced which would affect the tuning of the IF circuits; such as IF transformers, or 455 Kcs crystal.

If for any reason, the 455 Kcs IF system performs unsatisfactorily, it is strongly recommended that a standard tone modulated AM signal generator be used for thoroughly checking the performance of this receiver before proceeding with the alignment.

The IF alignment of the receiver can be accomplished by the sweep generator method and the AM single frequency method. The sweep generator method is the preferred method for re-alignment of the HQ-145X Communications Receiver because of the greater precision to which the IF coils can be adjusted. However, in view of the fact that there are a very limited number of 455 Kcs Sweep Generators available as test equipment, the alternate single frequency alignment method is also described.

SWEEP GENERATOR METHOD (PREFERRED)

The IF alignment of the receiver requires the use of a 455 Kcs sweep generator, an oscilloscope, and a phasing network for proper synchronization. Alignment should not be attempted unless suitable equipment is on hand and considerable experience in sweep alignment techniques has been acquired.

In practically all of the cases requiring re-alignment an over-all touch-up operation will be required. This is accomplished by connecting the sweep generator cable to the grid of the first mixer (pin 7-V2), and connecting the oscilloscope input cable across the volume control. Connect a large ceramic disc type of capacitor (.01 mfd) in series with the cable inner conductor (dc blocking capacitor).

Apply a small amount of sweep signal to the receiver and adjust the oscilloscope for a relatively large amount of gain and satisfactory picture size. Check the phasing control knob position to indicate the triangular indice and turn crystal knob to position "4". Adjust phasing network so that forward and return traces of the sweep co-incide.

Peak align 455 Kcs windings for maximum amplitude (T5 and T6 (top cores), T7, T9, T10, T11) and omit T8. Then turn crystal selectivity knob to position "1", and adjust T8 so that a tall selectivity curve with a slightly flattened peak is obtained. At the proper adjustment the abrupt change (spike) in the smooth selectivity curve will be located very close to the baseline of the trace, and the amplitude of the trace on positions "OFF" and "1" will be practically identical.

Re-adjust all 455 Kcs IF coils again (except T8) so that symmetry and phasing co-incide on positions "OFF, 1, 2, 3, and 4".

NOTE

The sweep generator frequency must be adjusted to obtain exact co-incidence of the forward and return trace. If complete co-incidence is not obtained, alternately make slight adjustments of the phasing control and sweep generator frequency until the images co-incide. After these steps have determined the exact frequency of the 455 Kcs crystal, the center frequency of the sweep generator should be re-adjusted.

SINGLE FREQUENCY METHOD (ALTERNATE)

Connect the output cable of the 455 Kcs unmodulated signal generator to the grid (pin 7) of the first mixer V2 and the chassis. Connect a dc vacuum tube voltmeter between the diode plate pin 1 (V6) 6AL5 socket and chassis.

Adjust the Front Panel Controls as specified above, and adjust the Signal Generator frequency for maximum output with crystal selectivity set to position "4". Turn to position No. "1" and peak align all 455 Kcs IF transformer windings (T5 and T6 top cores, T7, T8, T9, T10 and T11). Repeat procedure on crystal positions 1 and 4 to insure accurate coil adjustments.

BEAT FREQUENCY OSCILLATOR ALIGNMENT

With the same equipment and set-up as used in the preceding paragraph, turn crystal selectivity to position 5 and adjust the signal generator frequency for maximum reading. Turn signal generator modulation on, turn crystal selectivity off, and turn Send-Receive Switch to CW/SSB.

Loosen stop collar set screws on CW Pitch shaft (located directly behind the Front Panel). Turn CW Pitch knob for an audible zero beat on the loudspeaker. Tighten set screws so that the longer set screw is located in the mid-position with respect to the stop lug. Loosen the CW Pitch knob set screws and adjust knob indication so that it points vertically up on zero beat (mid-position).

3035 KCS IF ALIGNMENT

After 455 Kcs IF Alignment using either system, peak align the bottom cores of T5 and T6 by feeding in a 3035 Kcs signal in the same manner described in previous paragraph, and make certain that the Band Selector switch indicates 10-30 Mcs Range.

RF ALIGNMENT

1. The slugs and trimmers have been factory adjusted and should require a minimum amount of adjustment during re-alignment.

2 All Antenna, RF, and Oscillator coil adjustments are made from the top side of the chassis at the specified frequencies as shown in figure 9.
All trimmer adjustments are made at the specified frequencies as shown in figure 10.

3. Connect the unmodulated, signal generator output cable to the antenna and ground terminals of the receiver, with the Terminal A adjacent to the G terminal jumped together (See figure 4). Insert in series with the inner conductor of the output cable, a 100 ohm dummy antenna resistor.

4. Set the controls the same as for IF alignment as described above.
Adjust the Sensitivity Control as required to prevent overloading and also to obtain sufficient signal reading on the VTVM connected to pin 1 of V6 (6AL5).

5 The Oscillator Circuit is first adjusted to indicate proper dial calibration at the specified frequencies on each band, then the RF and finally the Antenna Circuits. A certain amount of interaction will occur between the Oscillator and RF adjustments, particularly on the higher frequency bands. Final adjustment should be accomplished by combined or alternate adjustment of the oscillator and RF for maximum amplitude and accurate dial calibration.

NOTE

The trimmer adjustments should always be the final adjustment for each band.

There is no adjustment of the RF Amplifier on the .54 to 1.6 Mcs band.

6. Note that the RF oscillator frequency in the HQ-145X is always located above the signal frequency by 455 Kcs for signals located below 10 Mcs., and by 3035 Kcs for signals located above 10 Mcs. It is necessary to make certain the oscillator frequency is always adjusted so that it is above the incoming signal frequency.

7. During RF alignment the Antenna Tuning Capacitor C3 must be placed in the mid-position of its range on all bands except the broadcast band.
On the broadcast band (.54 to 1.60 Mcs), the antenna tuning capacitor (C3) is adjusted to approximately 20 degrees from its maximum capacity position when the Main Dial indicates 600 Kcs. With this setting the Antenna Coil (T1) is peak aligned.
When the Main Dial indicates 1600 Kcs the Antenna tuning capacitor (C3) will tune for maximum signal at approximately 20^{o} from its minimum capacity. While tuning across the band, the capacitor setting required for maximum signal pick-up will progressively change from maximum to minimum as the frequency of received signal increases.

POSSIBLE RECEIVER DIFFICULTY

1. If upon turning the power "ON" the dial scales are not illuminated, and after two minutes of waiting the receiver still fails to operate, the clock timer switch is not making contact. Manipulate the Clock Timer Knob to indicate the "ON" position with the AC power switch, (Audio Gain Knob) "ON". The Clock Timer Switch should always point to the "ON" position unless the Automatic Timer is utilized.

2. Excessive hum usually is due to a defective 12AX7 tube (V7). This tube type may test good in a tube testing device but may be unusable because of higher than average heater-to-cathode leakage within the tube.

3. Poor Noise Limiter action is usually due to a poor or defective 6AL5 tube (V6). Remember that the use of the noise limiter will always result in some signal distortion for effective noise limiting action. When listening to strong broadcast stations or strong local signals, the VFO limiter switch should be in the VFO position unless slight distortion is preferable to excessive pulse type of noise, such as ignition interference.

4. Erratic or Poor "S" Meter performance is usually due to the two 6BA6 (V4 and V5) vacuum tubes. Merely interchanging these tubes may provide sufficient improvement. Replacing one or both of these tubes may be advisable before suspecting other troubles.

The majority of all receiver troubles have been found to be due to one or more defective tubes. Rough handling in shipment is largely responsible for the poor performance of the receiver.

Please, therefore, be sure to follow the above suggestions and have all vacuum tubes tested before writing to the Hammarlund Mfg. Co.

Instructions for Replacement of Antenna Trimmer Cord Assembly

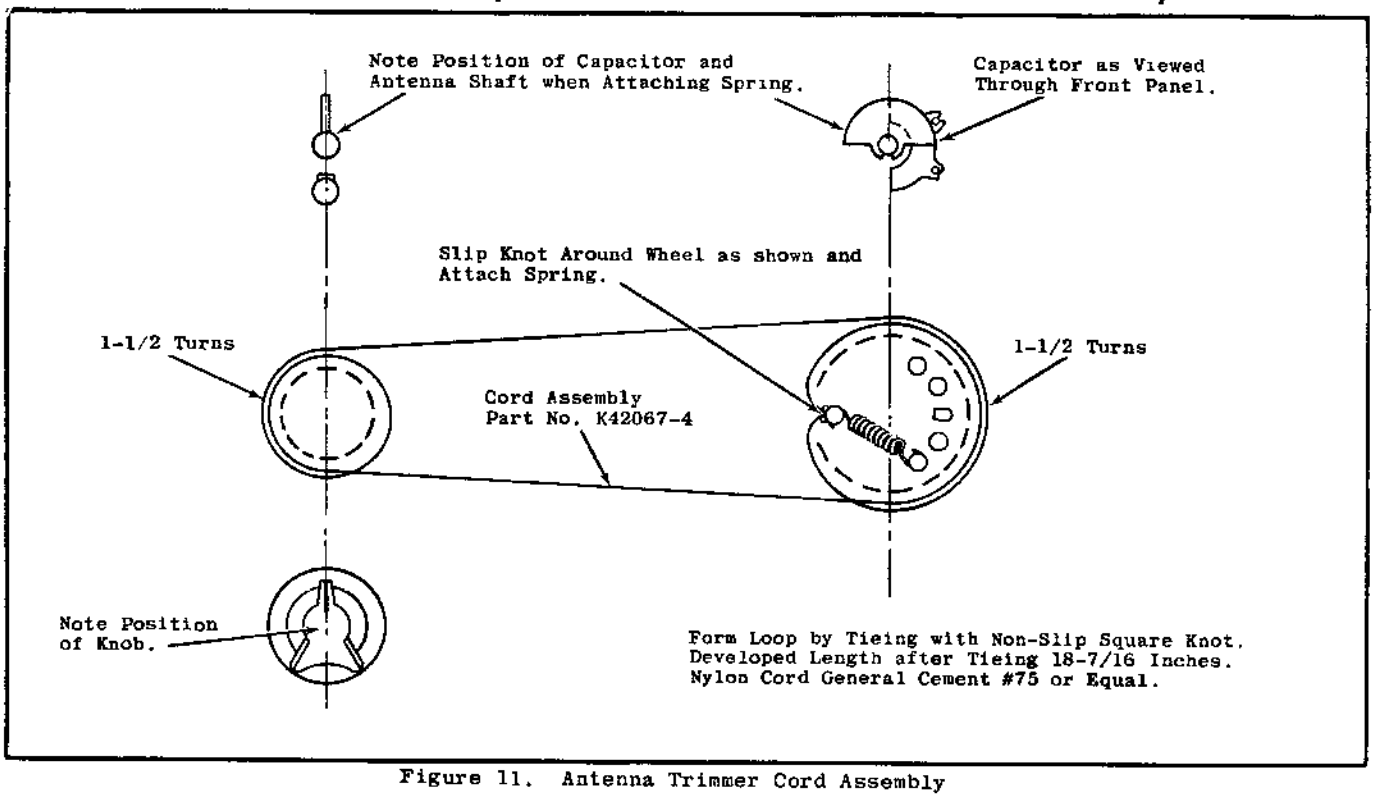


Figure 11. Antenna Trimmer Cord Assembly

TABLE 1. TUBE SOCKET VOLTAGES

Controls adjusted to the following positions unless otherwise specified:

Band - 10-30 Mcs
AVC ON-OFF Switch - OFF
Noise limiter - OFF

Function Switch - Receive
RF Gain - Max.
AF Gain - Max.

Antenna - Disconnected
Crystal Selectivity - OFF
AC line Volts - 117 V. AC

TUBE SOCKET		SOCKET PIN NUMBER								
		1	2	3	4	5	6	7	8	9
V1	RF Tube 6BZ6	0	1.55	0	6.3AC	245	105	0	--	--
V2	1st Mixer 6BE6	-1.6 to -7.5	1.2	0	6.3AC	243	80	0	--	--
V3	2nd Mixer 6BE6	-3.1	0	0	6.3AC	238	77	-.66	--	--
V4	IF Ampl. 6BA6	0	0	0	6.3AC	225	98	2.35	--	--
V5	IF Ampl. 6BA6	0	0	0	6.3AC	230	100	2.65	--	--
V6	DET. -NL 6AL5	-2.0	-3.2	0	6.3AC	0	0	-2.0	--	--
V7	Audio-BFO 12AX7	90	0	.75	6.3AC	6.3AC	168	-2.3	0	0
V8	PWR. Ampl. 6AQ5	0	15	0	6.3AC	255	245	0	--	--
V9	HF Osc. 6C4	100	--	6.3AC	0	--	-2.5 to -3.7	0	--	--
V10	Volt. Reg. 0B2	105	--	--	--	105	--	0	--	--
V11	Rectifier 5U4GB	Tie Point 6.3AC	265	--	260AC	--	260AC	--	265	--

TABLE 2. TUBE SOCKET RESISTANCES

CONDITIONS SAME AS IN THE TABLE 1. - TUBE SOCKET VOLTAGES.

PIN SOCKET		SOCKET PIN NUMBER								
		1	2	3	4	5	6	7	8	9
V1	RF Tube 6BZ6	10K	180	0	--	100K	100K	0	--	--
V2	1st Mixer 6BE6	47K	180	0	--	100K	100K	0	--	--
V3	2nd Mixer 6BE6	22K	0	0	--	100K	100K	100K	--	--
V4	IF Ampl. 6BA6	0	0	0	--	100K	100K	180	--	--
V5	IF Ampl. 6BA6	0	0	0	--	100K	100K	300	--	--
V6	DET. -NL 6AL5	1.2K	9.0	0	--	0	0	1.2M	--	--
V7	Audio-BFO 12AX7	600K	1.0M	2200	--	--	INF	47K	0	0
V8	PWR. Ampl. 6AQ5	500K	430	0	--	100K	100K	500K	--	--
V9	HF Osc. 6C4	100K	--	--	0	--	47K	0	--	--
V10	Volt. Reg. 0B2	100K	--	--	--	100K	--	0	--	--
V11	Rectifier 5U4GB	--	100K	--	60	--	60	--	100K	--

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
	CAPACITORS	
C1, A-C	Variable, Main tuning	T41604-3
C2, A-F	Variable, Bandspread	T41604-4
C3	Variable, Antenna Compensator, 3.7 - 50 mmf	K34454-G11
C4,C5,C6,C7,C8,C14, C15,C18,C19,C27,C28, C29,C31,C32,C33,C39, C55,C67,C68	Fixed, ceramic disc, .01 mf +80 -20%, 600V	M23034-19
C10	Fixed, Dur Mica DM-15 2 mmf ± .5 mmf, 500V	K23006-37
C12	Fixed, Dur Mica DM-19 560 mmf ± 5%, 500V	K23027-6
C13	Fixed, Dur Mica DM-15 20 mmf ± .5 mmf, 500V	K23006-17
C16	Variable, Crystal Filter 2.8 - 9.1 mmf	M11776-G2
C17,C34,C52,C53	Fixed, Dur Mica DM-15 100 mmf ± 10%, 500V	K23006-1
C20	Fixed, Dur Mica DM-19 1200 mmf, 500V	K23027-4
C21	Fixed, Mylar .038 mf, 200V	K23044-1
C22	Variable, Slot Tuning	K42041-1
C23,C24	Fixed, Ceramic Disc .01 mf ± 10%, 1000V	M23034-25
C25,C26,C66	Fixed, Ceramic Disc .045 mf + 80 - 20%, 600V	M23034-12
C30	Fixed, Ceramic Disc .005 mf GMV, 1000V	M23034-10
C35,C36,C37,C47,C49, C50,C51	Variable, Rotary Trimmer	K23008-1
C38	Fixed, Temp. Comp. Disc N 220, 12 mmf ± 5%, 1000V	K23010-2
C40,C41	Fixed, Temp. Comp. Disc N220, 2.7 mmf, 1000V	K23010-1
C42	Fixed, Temp. Comp. Disc N 750, 6.8 mmf ± 5%, 1000V	K23010-11
C43	Fixed, Dur Mica DM-19 1170 mmf, 500V	K23027-15
C44	Fixed, Dur Mica DM-20 3000 mmf ± 5%, 300V	K23041-8
C45	Fixed, Dur Mica DM-20 1300 mmf ± 2%, 300V	K23041-7
C46	Fixed, Dur Mica DM-15 430 mmf ± 1%, 300V	K23006-44
C48	Fixed, Temp. Comp. Disc N3300, 2.7 mmf ± .25 mmf, 500V	K23061-302
C54	Fixed, Temp. Comp. Disc N1400, 1.5 mmf ± .25 mmf, 500V	K23061-208C
C56	Fixed, Temp. Comp. Disc N750, 130 mmf, 500V	K23063-92E
C57	Fixed, Dur Mica DM-19 1200 mmf, 500V	K23027-13
C58,C59	Fixed, Dur Mica DM-30 4300 mmf, 500V	K23042-2
C60	Fixed, Dur Mica DM-15 12 mmf ± .5 mmf, 500V	K23006-45
C61	Fixed, Dur Mica DM-19 510 mmf, 500V	K23027-3
C62, A,B,C	Fixed, Electrolytic 40/60/25 mf 450/450/50V	K15504-64
C63,C64	Fixed, Ceramic Disc .01 mf GMV, 1400V	M23034-26
C65	Fixed, Dur Mica DM-15 8 mmf ± .5 mmf, 300V	K23006-31
C69	Fixed, Dur Mica DM-15 30 mmf ± .5 mmf, 500V	K23006-40
C70	Fixed, Dur Mica DM-15 25 mmf ± .5 mmf, 500V	K23006-41
C71	Variable, (MAPC-25)	K34451-2
	RESISTORS	
R1,R3	22 ohms, 1/2 w., ± 10%	K19309-9
R2,R4	180 ohms, 1/2 w., ± 10%	K19309-31
R5,R36,R38,R39	47K, 1/2 w., ± 10%	K19309-89
R6	6.2K, 1/2 w., ± 5%	K19309-176
R7,R10,R11,R19,R25, R26,R29,R34,R44	2.2K, 1/2 w., ± 10%	K19309-57
R8	22K, 1/2 w., ± 10%	K19309-81
R9	4.3K, 1/2 w., ± 5%	K19309-213
R12	300 ohms, 1/2 w., ± 5%	K19309-202
R13,R31	100 ohms, 1/2 w., ± 10%	K19309-25
R14	33 ohms, 1/2 w., ± 10%	K19309-13
R15	470K, 1/2 w., ± 10%	K19309-113
R16	180 ohms, 1/2 w., ± 5%	K19309-260
R17	1.2K, 1/2 w., ± 5%	K19309-268
R18	Variable, 10K, Sensitivity	K26219-5
R20	120 ohms, 1/2 w., ± 5%	K19309-258
R21	Variable, 200 ohms slot depth	K15368-7
R22	68 ohms, 1/2 w., + 5%	K19309-256
R23	39 ohms, 1/2 w., ± 5%	K19309-253
R24	Variable, 300 ohms, Zero Adj.	K15379-1
R27	Variable, 1.0 megohm, Audio Gain (Part of S6)	K38977-1
R28	47 ohms, 1/2 w., ± 10%	K19309-17
R30	430 ohms, 1 w., + 5%	K19310-212
R32	10K, 1/2 w., ± 10%	K19309-73
R33,R37	1K, 1/2 w., ± 10%	K19309-49
R35	10 ohms, 1/2 w., ± 10%	K19309-1
R40	100K, 1 w., ± 10%	K19310-97
R41	4K, 10 w., ± 10%	K19337-3
R42	100K, 1/2 w., ± 10%	K19309-97
R43	6.8 megohms, 1/2 w., ± 10%	K19309-141
R45	100K 1/2 w., ± 10%	K19309-97

PARTS LIST HQ-145X (CONT)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
	COILS	
L1	RF Choke, 38 microhenries	K15629-1
L2	Bifilar coil	K42032-1
L3	Slot Frequency Inductor Assembly	K42034-1
L4	RF Coil Assembly, .54 to 1.6 Mcs, 1.6 to 4.0 Mcs (Bands 1 and 2)	K38816-1
L5	RF Coil Assembly, 4.0 to 10.0 Mcs, 10.0 to 30.0 Mcs (Bands 3 and 4)	K38817-1
L6	Osc Coil Assembly, .54 to 1.6 Mcs, 1.6 to 4.0 Mcs (Bands 1 and 2)	K38818-1
L7	Osc Coil Assembly, 4.0 to 10.0 Mcs, 10.0 to 30.0 Mcs (Bands 3 and 4)	K38819-1
L8	BFO Coil and Ferrule Ansembly	K38989-G1
L9	Reactor	K38939-1
L10	RF Choke, 1 Microhenry	K15629-3
	TRANSFORMERS	
T1	No. 1 Antenna Coil Assembly .54 to 1.6 Mcs	K38812-1
T2	No. 2 Antenna Coil Assembly 1.6 to 4.0 Mcs	K38813-1
T3	No. 3 Antenna Coil Assembly 4.0 to 10.0 Mcs	K38814-1
T4	No. 4 Antenna Coil Assembly 10.0 to 30.0 Mcs	K38815-1
T5,T6	IF transformer, composite 3035 and 455 KC	M26402-2
T7,T8	IF transformer, crystal	K25399-1
T9,T10	IF transformer	K38946-1
T11	IF transformer	K38829-1
T12	Audio output transformer	K38828-1
T13 (HQ-145X) (HQ-145XC)	Power transformer 117 Volt primary	P38938-1
T13 (HQ-145XE)	Power transformer 230/115 Volt primary	P38938-2
	SWITCHES	
S1 A,B,C	Switch, wafer, Ant, RF, Osc	K38824-1
S1 D	Switch, wafer, Osc, 2nd Mixer	K26377-1
S2	Switch, Selectivity	K26396-1
S4	Switch, SPST (AVC ON-OFF)	K38857-1
S5	Switch, Send-Receive-CW/SSG-Cal	K26395-1
S6	Switch, Power ON-OFF (part of R27) SPST	
S7	Switch, VFO/VFO-LIM/XTL/XTL-LIM	K52016-1
	SPECIAL ASSEMBLIES	
CMC	Crystal panel, clock window	K38877-1
M1	Clock, Telechron auto-timer	K38874-G2
Y1	Meter, "S" (Carrier Level) with Hardware	K26149-4
Y2	Quartz crystal, 2.560 Mcs	K38972-2
Z1	Quartz crystal, 455 Kcs	K26404-1
Z2	RC printed network (AVC-Noise Limiter)	K38885-1
	RC printed network (Audio)	K38846-1
	PLUG AND CRYSTAL CALIBRATOR (ACCESSORY) PL 38653-G7	
C301	Capacitor Fixed, silver mica, 100 mmf 500 W.V.D.C.	K23006-1
C302	Capacitor, Variable, Frequency Adjust	K23038-5
Y301	Quartz crystal, 100 Kcs	K38661-1
Z301	RC printed network (Calibrator)	K38981-1
	Socket Crystal	K16092-5
	Power Plug	K26412-1
	Power Plug Cover	K26419-1
V301	Tube, Electron 6BZ6	K16388-1
	MISCELLANEOUS	
I1,I2	Lamp pilot, No. 47 6.3 V., .15 A.	K16004-1
J2	Power Outlet (Relay)	K35013-1
J1	Phone Jack	K35608-1
	Spring, Tension	K38895-1
	Nylon Cord (Antenna Trimmer)	K42067-4
	Knob (3/4" Dia.)	K26216-3
	Knob (1" Dia.)	K26224-2
	Knob (1" Dia.)(White Line)	K26224-1
	Knob, Bar	K26243-1
	Knob (2" Dia.)	K26226-1
	Knob, (Pointer Type)	K26229-1
	Window	K26406-1
	Spring	K26273-1
	OPTIONAL ACCESSORIES	
	Plug-in crystal calibrator assembly XC-100P	PL38653-G7
	Telechron Clock Assembly Conversion Kit including instructions for converting model HQ-145X to model HQ-145XC	PL26380-G1
	Loudspeaker Assembly in cabinet matched to the models HQ-145X, HQ-145XC, and HQ-145XE	PL26394-G1

PARTS LIST HQ-145X (CONT)

SCHEMATIC DESIGNATION	DESCRIPTION	HAMMARLUND PART NO.
	TUBES	
V1	Electron, 6BZ6	K16388-1
V2,V3	Electron, 6BE6	K16284-1
V4,V5	Electron, 6BA6	K16283-1
V6	Electron, 6AL5	K16294-1
V7	Electron, 12AX7	K16300-1
V8	Electron, 6AQ5	K16387-1
V9	Electron, 6C4	K16288-1
V10	Electron, OB2	K16375-1
V11	Electron, 5U4-GB	K16215-2

MAINTENANCE

The HQ-145X is designed to give years of trouble-free service. Tube failure is the most common source of trouble. The second most common cause of difficulty is component failure among small resistors and fixed capacitors.

The following charts give voltages and resistances between tube socket terminals and chassis. Voltages indicated are those measured with a vacuum tube voltmeter; resistances with a vacuum tube ohmmeter. Slight variations in the order of 10 percent from indicated values should be disregarded.

With the aid of the chart and schematic diagram, components can usually be located. The parts listing in the back pages of this manual gives component values and Hammarlund part numbers.

Standard items may be purchased locally, non-standard components are available on order from the factory.

A sensitive communications receiver should be entrusted only to a qualified technician. Should difficulty be experienced, please write Hammarlund Manufacturing Company, for advice or to arrange for factory service.

MEMORANDA

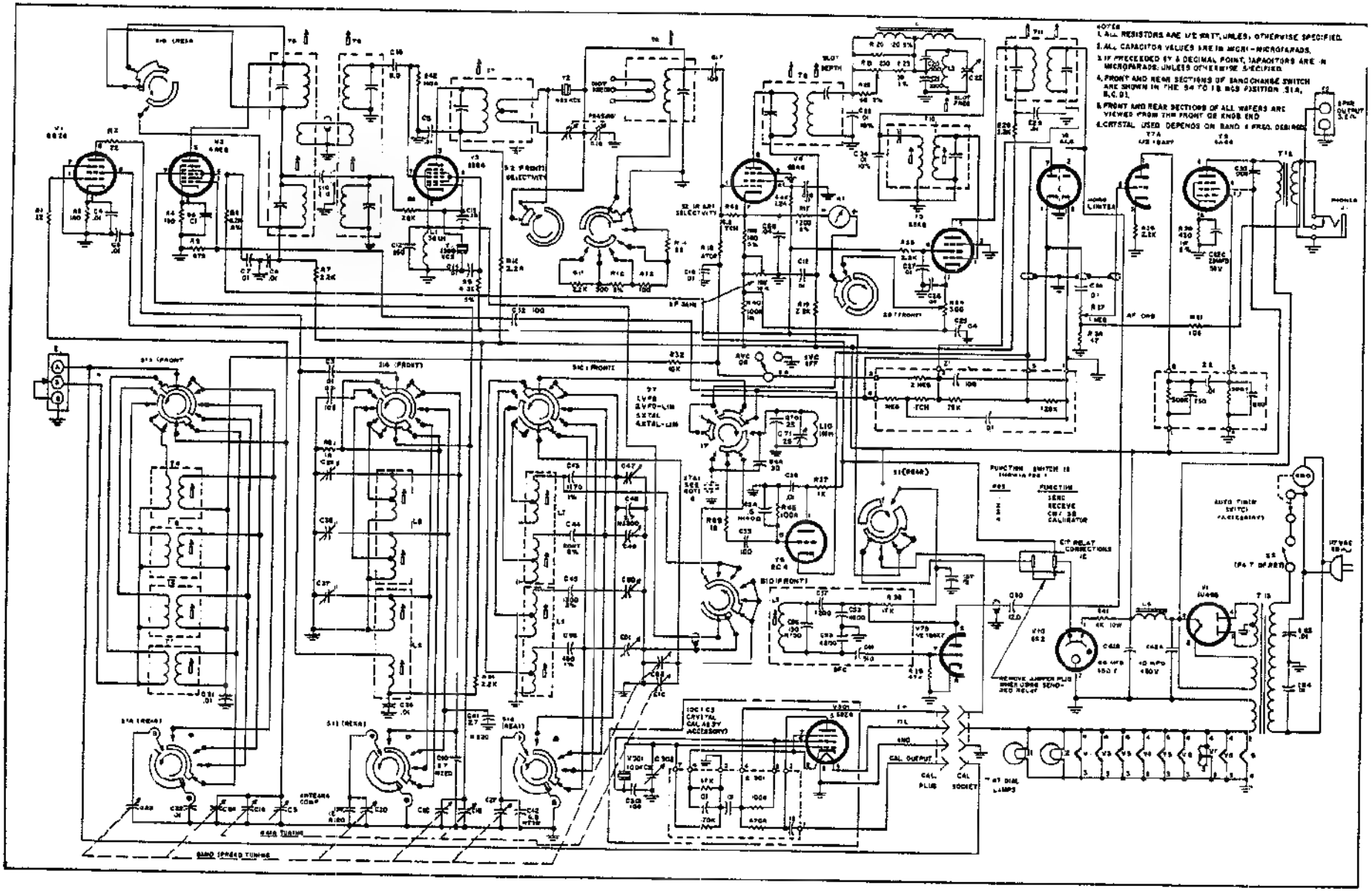
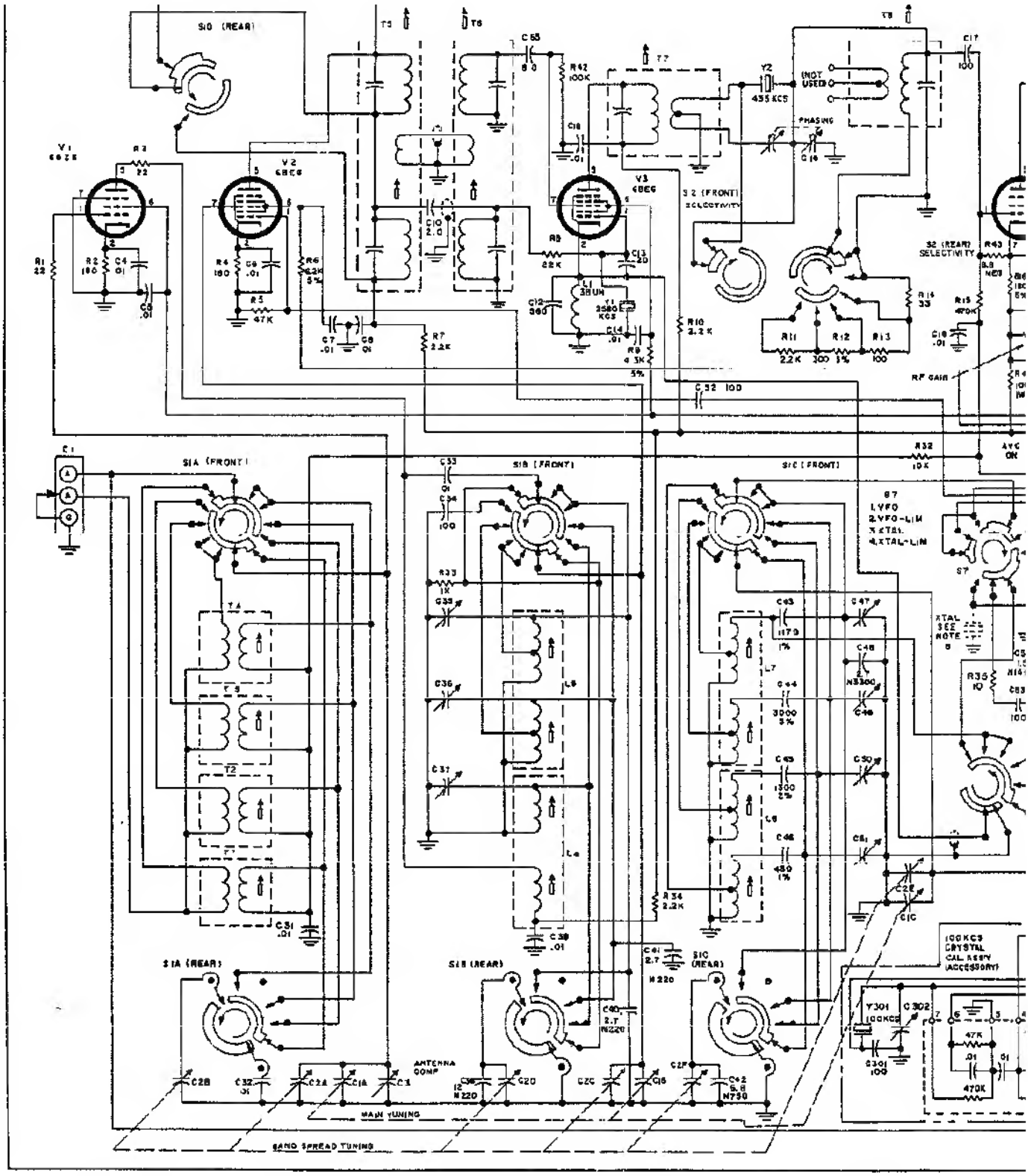


Figure 12. Hammarlund HQ-145X Communications Receiver, Schematic Diagram


S10 (REAR)
V1 6BZ6
V2 6BC6
V3 6BE6
S2 (FRONT) SELECTIVITY
S2 (REAR) SELECTIVITY
PHASING
(NOT USED)
455 KCS
RF GAIN
S1A (FRONT)
S1B (FRONT)
S1C (FRONT)
S7 LVFO 2 VFO-LIM 3 XTAL 4 XTAL-LIM
XTAL SEE NOTE 8
S1A (REAR)
S1B (REAR)
S1C (REAR)
ANTENNA COMP
MAIN TUNING
BAND SPREAD TUNING
100KCS CRYSTAL CAL ASSY (ACCESSORY)
Y301 100KCS
C301 100
C302
470K

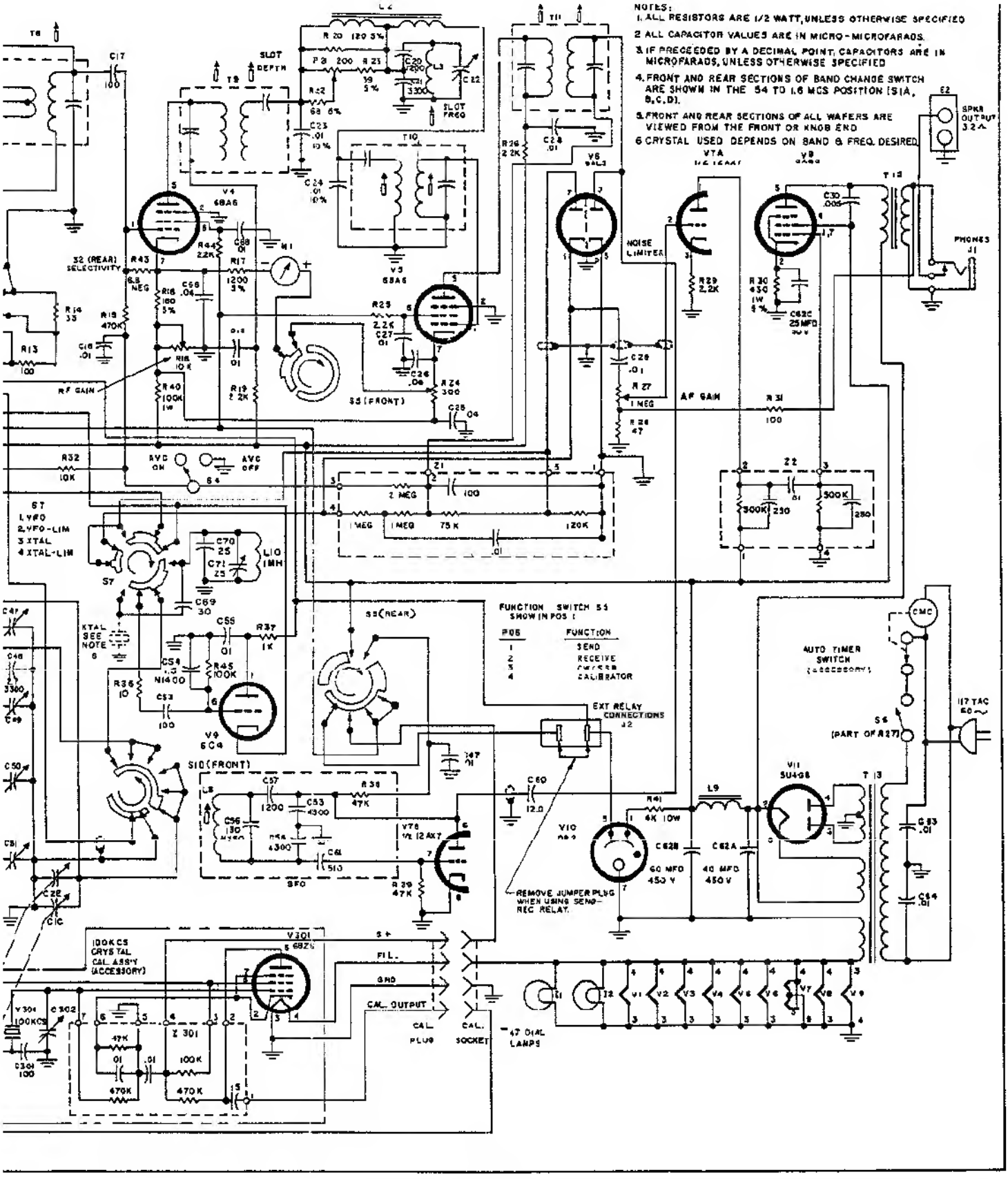


Figure 12. Hammarlund HQ-145X Communications Receiver, Schematic Diagram

THE HAMMARLUND MANUFACTURING COMPANY
Standard Warranty

The Hammarlund Manufacturing Company, warrants this equipment to be free from defects in workmanship and materials under normal and proper use and service for the uses and purposes for which it is designed, and agrees to repair or replace, without charge, all parts thereof showing such defects which are returned for inspection to the Company's factory, transportation prepaid, within a period of 90 days from date of delivery, provided such inspection discloses to the satisfaction of the Company that the defects are as claimed, and provided also, that the equipment has not been altered, repaired, subjected to misuse, negligence or accident, or damaged by lightning, excessive current or otherwise, or had its serial number or any part thereof altered, defaced, or removed. Tubes shall be deemed to be covered by the manufacturer's standard warranty applicable thereto, and such items shall be and are hereby excluded from the provisions of this warranty. Pilot lamps and fuses are not guaranteed for length of service.

Except as herein specifically provided, no warranty, express or implied, other than that of title, shall apply to any equipment sold hereunder. In no event shall the Company be liable for damages by reason of the failure of the equipment to function properly or for any consequential damages.

This Warranty is valid for the original owner of the equipment, and is contingent upon receipt of the Warranty Registration Card by the Company. No equipment shall be returned to the factory for repairs under warranty unless written authorization is obtained by the Company, and the equipment is shipped prepaid by the owner. The Company maintains Authorized Service Stations, names and locations of which will be sent upon request of the owner.

The Hammarlund Manufacturing Company
A Giannini Scientific Co.
53 West 23rd Street, New York 10, N. Y.
Export Department: 13 East 40th Street, New York 16, N. Y.

The policy of the Hammarlund Manufacturing Company, is one of continued improvement in design and manufacture wherever and whenever possible, to provide the highest attainable quality and performance. Hence, specifications, finishes, etc. are subject to change without notice and without assumption by Hammarlund of any obligation or responsibility to provide such features as may be changed, added or dropped from previous production runs of this equipment.

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DO NOT MAKE ANY RETURNS WITHOUT AUTHORIZATION FROM EITHER NEW YORK OFFICE OR FACTORY. ALL AUTHORIZED RETURNS SHOULD BE SHIPPED TO FACTORY, HAMMARLUND MANUFACTURING CO., MARS HILL, NORTH CAROLINA. DO NOT SHIP TO NEW YORK OFFICE.

ESTABLISHED 1910